Title: Rescue Rendezvous: Can a Search and Rescue Team Reach an Endangered Teen Pilot in Time?

> "Anyone who has never made a mistake has never tried anything new. Everything should be made as simple as possible, but not simpler."
>
> --Einstein

Brief Overview:

Like Brian in Gary Paulsen's novel, *Hatchet*, Laura, 15 years old, was the sole passenger on a small airplane when the pilot had a heart attack and died. Fortunately, Laura had listened carefully when, before and soon after takeoff, the pilot had explained the theory of flying a small aircraft. When the pilot became incapacitated, Laura had to send a distress signal and then make several calculations in order to predict a landing place that could be communicated by radio to emergency personnel. In this lesson students, playing the role either of Laura or emergency team members, estimate the landing place, compare predictions and consider whether the two predictions would have been close enough to allow a search and rescue team to be nearby when the plane finally lands. Besides the literary connection with Hatchet, a musical piece entitled "Flying Without Wings" is provided to appeal to learners and broaden the sense of involvement. The musical selection is from a High School Band in Grundy County, Tennessee, composed of students with learning disabilities. The powerpoint video lists places they were invited to perform concerts. The lyrics are poignant for the story being portrayed in this lesson. A soundtrack that can be used without the video is also included as a separate file. (See resources.)

NCTM Content Standard/National Science Education Standard:

Data Analysis and Probability

- Students will select and use appropriate statistical methods to analyze data. In the middle grades, students should learn to use the mean, and continue to use the median and the mode, to describe the center of a set of data.
- Students will develop and evaluate inferences and predictions that are based on data. In collecting and representing data, students should be driven by a desire to answer questions on the basis of data. In the process, they should make observations, inferences, and conjectures and develop new questions.

Problem Solving

- Students will build new mathematical knowledge through problem solving.
- Students will solve problems that arise in mathematics and in other contexts; apply and adapt a variety of appropriate strategies to solve problems; monitor and reflect on the process of mathematical problem solving. Included are model calculations from textbooks and other sources for calculating distance, time and rate of speed, creating a scatter plot, using Pythagoras's theorem, creating and comparing data using box and whiskers plots, determining mean, median and mode and using the X-Y axes to coordinate and estimate position and estimated arrival.

Grade/Level:

Grades 6 through 8, all levels

Duration/Length:

Three 45 – minute lessons

Student Outcomes:

Students will:

- Organize and Display Data to Make a Scatter Plot
- Interpret Maps and Tables
- Use Pythagoras' theorem to calculate distances by creating triangle overlays on a map
- Demonstrate change in location and movement on three axes
- Analyze measures of central tendency to determine or apply mean, median, mode
- Interpret Box-and-Whisker Plots
- Compare multiple Box-and-Whisker Plots having the same scale

Materials and Resources:

- Narrative and data packets for students: who will be pilot advisors and ground support planners, organized into teams to do various tasks including planning, analysis, communication with pilot, communication with emergency agencies like fire departments, the Civil Air Patrol, and similar organizations. Students may consult with community members who may have had rescue experiences in the military or civilian life, and get their advice to strategize. The KWHL sheet will be an assessment tool for the teacher to check student participation and progress in doing research and reports.
- Model airplane, or paper airplane, preferable with visible wings, rudder and tailfins, (Commercial kit, not required The Paper Airplane Kit, available from Barnes and Noble. see resource list,) to demonstrate axes, roll, lift, pitch, thrust, and yaw. These are explained in diagrams and the vocabulary list.
- Roll is the action of the wingtips rising or falling. Lift is the effect of the airfoil, including wings and fuselage, when air pressure is lower above than beneath. Pitch is the angle (slope) of the nose of the plane. Thrust is the forward movement created by the propeller (or lack of it, when the engine is slowed, or runs out of fuel, resulting in a stall or fall.) Yaw is the "slide of the plane diagonally when forces such as wind and turning by adjusting controls, including ailerons, rudder and elevators (tailfins).to use in simulated plane movement s
- {see pages from the Federal Aviation Agency, Handbook of Aeronautical Knowledge, 1964, in the resource list attached.}

Development/Procedures:

Lesson 1

Preassessment – KWHL Chart: Teacher will write on large sheet, or overhead template, or board: Introduce FAA summary that notes--no fatalities in the past 3 years on commercial airliners in the US, with more than 2 billion people (7 times the U.S. population) who took flights. Show graphic from Federal Aviation Agency of a trio of smoke circles (attachment 2) that reads: Our job is to make a difference every day. Ask: How safe do you think our skies are? Lead a discussion about air safety, and ask students if they would like to attend a guest speaker presentation on the subject, possibly from a Homeland Security, National Security Agency, Civil Air Patrol, or similar organization. Pass out KWHL sheets (attachment 3) for students to write their own ideas.

What do we know about air travel emergencies? Flight? Search and Rescue? What do need to know to calculate and participate in safe flight? What are the basic mechanisms discovered by the Wright brothers that control three axes of movement in flight? What are they called? Use illustrations from Federal Aviation Administration Private Pilot's Handbook of Aeronautical Knowledge, 1965. Attachments 4,5,6,7,8 and 9)

Who has flown on a commercial flight? Private plane? Helicopter? (Share stories) Who has read the story of Brian in Gary Paulsen's book, *Hatchet*?

Launch –Teacher selects or has a volunteer read the dialogue: Laura's dilemma. (See attachment 10. To prepare for decision making in a situation like this, we will divide the class into two groups. One group will form a team to answer essential questions for a pilot just deployed in the cockpit of a small plane. Basic flight controls, visual flight guidelines, and navigation instruments will be introduced with overhead illustrations and a discussion of their usage. The second group will team up to become experts on advising the fledgling pilot, Laura as she flies her plane from Toronto to Annapolis. In case she crashes, they must have search and rescue people, ambulances and firefighters, standing by in the areas they calculate to be most likely landing sites. Ground support team members may scour magazines, books, the Internet, or contact and interview people in the community who may have served in rescue operations in the military, or organizations like the Civil Air Patrol or U.S. Coast Guard. Members will consider the maps, flight information received in real time from radio transmissions and flight control towers, and messages relayed from the pilot. The goal is to accumulate critical relevant knowledge to make the best decisions and safe outcome. Rescue team participants will complete a search and rescue preparation form.

Teacher Facilitation – After directing initial discussion, the teacher will use a musical interlude, "Flying Without Wings," a vocabulary sheet that explains flight terms, basic flight calculations, and essential explanations, for each team to use in preparing for the critical moments. Maps will be issued to each team, as well as a search and rescue guide for the rescuers. The cockpit team to develop a projected landing will use a flight plan filed by the pilot.

Student Application Students will select team members to record, direct information, communicate, and report on incident management.

Embedded Assessment Each student will support team success by passing drill readiness in the form of pre-flight checklist (vocabulary), completion of writing sentences using vocabulary words.

Reteaching/Extension –

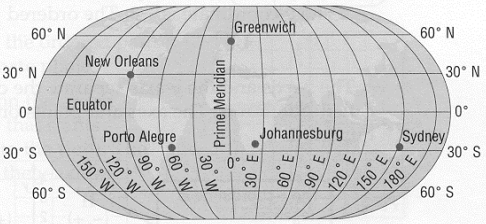
- The teacher will check flight preparedness by giving a quiz on essential questions.
- **Quiz:**
- 1.What is the number of degrees in the three axes that a pilot must deal with? Answer: Each axis consists of 360 degrees.
- 2. What formula can be used to calculate time and distance and rate of speed? Answer: Distance = Rate X Time.
- 3. How can the distance formula be adjusted to calculate time? Answer: Divide Distance by rate or time to obtain the quantity you need to calculate. For example, D/R = T or D/T = R
- 4. What value is there in using box and whisker plots to compare data? Answer: Box and whisker plots give a good indication of the amount of variable quantities with easy comparison of data sets.
- 5. What agencies manage air space and coordinate search and rescue in the United States? Answer: The Federal Aviation Agency, (FAA.gov), with cooperation by the Civil Air Patrol (CAP.gov.)
- The teacher will encourage students to practice attacking unknown and unexpected challenges by using mathematical knowledge.

Lesson 2

Preassessment: Building on Lesson 1, students will identify locations by latitude and longitude on a world map.

How is a coordinate system used to locate places on Earth?

A GPS, or Global Positioning System, can be used to find a location anywhere on Earth by identifying its latitude and longitude. Several cities are shown on the map below. For example, Sydney, Australia, is located at approximately 30°S, 150°E.



a. Latitude is measured north and south of the equator. What is the latitude of New Orleans?

b. Longitude is measured east and west of the prime meridian. What is the longitude of New Orleans?

c. What does the location 30°N, 90°W mean?

Launch: Teacher explains that, in groups, students will play one of two roles in a story similar to Gary Paulsen's *Hatchet*, in which a teenage boy has to try to land a small private safely after the pilot dies suddenly of a heart attack. Students will adopt either the boy's point of view or the point of view of members of an emergency search and rescue team on the ground and make an estimate of the plane's likely landing place.

Teacher Facilitation: Teacher provides story details, either orally or in writing, and then divides class into teams. Each team selects a record manager, a scribe, a facilitator, and a report reviewer. work starts with the facilitator who asks the record manager to pass out exhibits. A scribe notes each team member and the items received by each. The facilitator leads a discussion of the items and the scribe writes down the main ideas along with suggested problem solvers. All members work on the problems together. The report manager checks each participant's contribution, reviews with other team member input, and works with the scribe to write additional comments and the consensus, of the team's recommendations or need for further study. Student Application: Each student will receive a packet containing a filled out plan that the pilot prepared, a map, a sheet with locations indicated in the form of a scatter plot, reference data concerning (1) average or typical wind speeds for each day in June; (2) average or typical wind direction for each day in June; and (3) coordinates of 9 possible landing sites in the greater Annapolis area. The landing site data will be the same for both groups, but the wind tables will be different, with "plane" groups having only Toronto data and "rescue" groups having only Baltimore data.

Embedded Assessment: Students will be required to make 2 box and whisker plots, one of relevant wind speed data and one of relevant wind direction data. Students will also be required to plot points on a latitude-longitude grid.

Reteaching/Extension: First "plane" groups and then "rescue" groups will report on their estimate of the plane's likely landing place and explain their reasoning. Teacher will review the principle that wind speed and wind direction affect likely landing place.

Lesson 3

Preassessment: Students will turn in homework after the teams have reviewed results, the report managers have made their conclusions, and the scribes have recorded summaries of findings.

The following exercise is designed to familiarize students with finding map coordinates for longitude and latitude.

GEOGRAPHY Latitude and longitude lines form a system of coordinates to designate locations on Earth. Latitude lines run east and west and are the first coordinate of the ordered pairs. Longitude lines run north and south and are the second coordinate of the ordered pairs.

a. Name the city at (40°, 105°).
Locate the latitude line at 40°. Follow the line until it intersects with the longitude line at 105°. The city is Denver.

b. Estimate the latitude and longitude of Washington, D.C.
Locate Washington, D.C., on the map. It is close to 40° latitude and 75° longitude. There are 5° between each line, so a good estimate is 39° for the latitude and 77° for the longitude.

Launch: Teacher will ask students to re-form their groups from Day 2.

Teacher Facilitation: Teacher will demonstrate the use of box plots, mean, median, mode, plotting on the X and Y axes, and use of a 360 degree protractor to determine the course of Laura's airplane from various points on the map. The distance, time and rate of speed calculations will be reviewed, and the various math tools discussed. Problems are then assigned to the teams to work out in class. Students may work together with teacher guidance. Progress is reviewed and activities are assigned for homework. Students are encouraged to collaborate and review their solutions that

will be written by their scribe and reported to the class during the next meeting. The goal is for pilot advisors and ground crews to come up with similar results for a safe landing. Critical factors to be checked are: time and distance flown, taking various routes, fuel consumption comparisons for different wind and routes, and the best place and time to land safely: When the fuel is spent, to reduce chance of explosion, in water (Laura is an excellent swimmer, and there is less chance of the plane breaking upon impact and hurting her) Students turn in their class work for grading or consideration for their portfolios.

Student Application: Teams will work together on calculations, plots as progress takes place on the route reached by consensus, and solutions with predictions made at hourly intervals. The flight time is assumed to be six hours, so there should be six calculations or comparisons altogether. Students report to their report manager and scribe to complete the process based on their choices. Team spokespersons report findings to the class.
Embedded Assessment: Students will write a paragraph about what they learned and liked or disliked about the exercise.

Reteaching/Extension: Teacher will ask students to share and then reinforce key points made by students.

Summative Assessment:

Students will be given a constructed response assignment to report their research in the form of an organized paper that explains various methods used in map reading, distance/time/rate of speed, measurement and scale, and safety methods in a mode of travel of their choice: Rail, body of water/boat, auto, or dogsled. A rubric will be provided that indicates required components and credit for each level of performance.

Authors:

Murray Newman
Maryland School for the Blind
Baltimore City

George Mitchell
Mary E. Moss Academy
Anne Arundel County Public Schools